Education as social infrastructure

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Motivation and Overview

- Starting point is Corrado, Haskel and Jona-Lasinio (2015) SPINTAN framework document
- This presentation concentrates on applying the Jorgenson Fraumeni framework to this model to measure investment in education services
  - Discusses a number of conceptual issues
- Also considers the issue of the appropriate deflator
- Concludes with an overview of data sources

Corrado, Haskel and Jona-Lasinio (2015)

- Sees education services as producing a societal asset
- Society's consumption of education services is the acquisition of schooling knowledge assets ΔE whose change in value $P^{ES} \Delta E$ should be included in saving and wealth
- Education services production is the schooling-produced increment to the beginning period knowledge stocks held by this years students.
- The idea is to link this to the lifetime earnings approach of Jorgenson and Fraumeni

The Jorgenson-Fraumeni framework

Discussion based on Christian (2010)

Calculates the values of human capital stocks based on lifetime incomes by sex (s), age (a) and education level (e).

Let pop = population,

y = current market income

li = lifetime income

δ = the discount rate

g = average income growth

senr = the enrolment rate

sr = the survival rate.

The Jorgenson-Fraumeni framework

The model calculates lifetime incomes recursively. First consider those above the age of education enrolment (35+). Assume market income is 0 beyond some age, say 80. For persons aged 80, lifetime income in year t is just current labour income.

$$li_{s,a=80,e,t} = y_{s,a=80,e,t}$$

For those aged 79, li is current labour market income plus discounted future income of those aged 80 with the same education and gender, conditional on survival:

$$li_{s,a=79,e,t} = y_{s,a=79,e,t} + sr_{s,a=80,e,t} \frac{1+g}{1+\delta} y_{s,a=80,e,t}$$

The Jorgenson-Fraumeni framework

In general the lifetime income of those aged 35+ is given by:

$$li_{s,a,e,t} = y_{s,a,e,t} + sr_{s,a+1,e,t} \frac{1+g}{1+\delta} li_{s,a+1,e,t} \mid a \geq 35$$

This assumes that the best estimate of a person's income next year is that earned by a similar person this year who is one year older.

The Jorgenson-Fraumeni framework

For persons aged between 5 and 34, lifetime income takes account of if they are enrolled in education or not. For these age groups:

$$li_{s,a,e,t} = y_{s,a,e,t} + sr_{s,a+1,e,t}\frac{1+g}{1+\delta}\left[senr_{s,a,e,t}li_{s,a+1,e+1,t} + (1-senr_{s,a,e,t})li_{s,a+1,e,t}\right] \mid 5 \le a < 35$$

Their income depends on if they stay in education, in which case they earn li associated with education level e+1, or leave school and earn li associated with education level e.

For those aged 0-4 the calculation is similar to those aged 35+ except current income is zero and their e is the lowest level.

The Jorgenson-Fraumeni framework

- The total value of the human capital stock in year t can be calculated by summing the lifetime earnings by s, a and e:

$$HC_t = \sum_s \sum_a \sum_e pop_{s,a,e,t} li_{s,a,e,t}$$

Christian (2010) defines net investment in human capital (NIH) as the effect of changes from year to year in the size and distribution of populations. This is given by:

$$NIH_t = \sum_s \sum_a \sum_e (pop_{s,a,e,t+1} - pop_{s,a,e,t}) li_{s,a,e,t}$$

This comprises various components including births, deaths, *"investment from education of persons enrolled in school"* and depreciation and aging of persons not enrolled in school.

Investment in Education

The term corresponding to those enrolled in school which we use for nominal investment in education is given by:

$$NIH(enr)_t = \sum_s \sum_a \sum_e (enr_{s,a,e,t+1} - enr_{s,a,e,t}) \left[\frac{1+g}{1+\delta} sr_{s,a+1,e,t} li_{s,a+1,e^*,t} \right]$$

Where enr are enrolments, and

$$li_{s,a+1,e^*,t} = [senr_{s,a+1,e,t} li_{s,a+1,e+1,t} + (1 - senr_{s,a+1,e,t}) li_{s,a+1,e,t}]$$

Which depends as before on if those enrolled stay on or leave education

Issues in calculating investment in education

We identify three main conceptual issues in estimating investment in education

- Attribution
- Survival rates
- Growth in income and the discount rate

Attribution

- Some part of lifetime earnings is a return to experience or employer provided training
- To capture the component arising from education we could:
  - Assume income is constant at the graduation earnings through time. In that case the lifetime income stream only depends on how long the person is in the workforce after graduation.
  - A variant of this would use an average of earnings a few years after graduation
  - Base the earnings on Mincer wage equations, controlling for experience and other factors likely to affect earnings
- The calculations should also take account of the opportunity costs of staying in education beyond the age of compulsory education.

Survival rates (sr)

- If we only consider income of the working population then sr takes account of both mortality and retirement
- Both are permanent exits from the labour market
- Should we also take account of short term transitions, e.g. unemployment or labour market exit due to child rearing etc.
- If we ignore employment probabilities we are estimating the potential human capital - equivalent to ignoring utilisation rates for physical capital.

Growth in income and the discount rate

- Does the “g” that determines income growth include productivity and/or inflation gains. In other words, are nominal holding period gains to schooling part of the value of human capital
- This might be a capital gain in the national accounting sense as in:

$$\Delta(P^{ES}E) = P^{ES}\Delta E + \Delta P^{ES}E$$

- The second term probably should not be included as per the usual exclusion of asset valuation changes from GDP. In this case it makes sense to set g=0.
- Should the discount rate be set equal to the SRTP as in Corrado and Jaeger (2015)

Education services and education costs

What is the relationship between our nominal value of investment and expenditures on education? This could be a measure of effectiveness, i.e.

$$P^{ES}\Delta E = \gamma * EDCosts$$

where γ can be equal to, greater than, or less than one.

If γ > 1 then could be a measure of quality.

γ < 1 could be capturing penalty exacted from society due to resources of the school system not being used effectively, e.g. due to unemployment.

We could use assumption on employment probabilities to get a handle on this.

Deflators

- Could estimate an implicit deflator by taking the ratio of nominal investment to real output growth as estimated by other authors (Gu and Wong, O'Mahony and Stevens). This is given by:

$$\ln \frac{E_t}{E_{t-1}} = \sum_{s,a,e} \bar{v} \left[\ln \frac{enr_{s,a,e,t}}{enr_{s,a,e,t-1}} \right]$$

Where $\bar{v}$ is the share of individuals with s, e, a in the total value of investment in education, averaged over year t-1 and t.

We could also use the consumer price index. This captures the opportunity cost of foregoing current consumption for investments in schooling.

Data Sources

- National and EU Labour Force Surveys
  - Earnings only available in this source for the UK and US
- EU Structure of Earnings Survey (SES)
  - Firm level survey but excludes small firms, only available for 2002, 2006, 2010
- EU SILC
  - Individual survey available annually
- Enrolment statistics from US and Eurostat
- Life Tables

Next Steps

- Continue working on the concepts, e.g. how to define the stock of education services
- Estimate investment in education using alternative assumptions for a few countries (probably UK and US)
- Then apply to other EU countries